

"Instructed Response"

Developing Reading, Writing and Thinking Skills with Non-Routine Problems

Kari Augustine,
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Wisconsin Math Council, May 1, 2008

*Assessment is about several things at once. It is not about simple dualities such as **grading** versus **diagnosis**. It is about **reporting on student's achievements** and about **teaching** [students] better through expressing to them more clearly the **goals of our curricula**.*

It is about measuring students learning and it is about diagnosing specific misunderstandings in order to help students to learn more effectively. It concerns the quality of teachings as well as the quality of learning: it involves us in learning from our student's experiences, and is about changing ourselves as well as our students. It is not only about what students can do; it is also about what it means he or she can do.

Remden 1999, Learning to Teach in Higher Education

"Problem solving ..."

is not a distinct topic, but a process that should permeate the study of mathematics and provide context in which concepts and skills are learned."

~ NCTM, 2000, p. 182

Executive Summary
 Principles and Standards for School Mathematics

Process Standards

Problem Solving. Solving problems is not only a goal of learning mathematics but also a major means of doing so. It is an integral part of mathematics, not an isolated piece of the mathematics program. Students require frequent opportunities to formulate, grapple with, and solve complex problems that involve a significant amount of effort. They are to be encouraged to reflect on their thinking during the problem-solving process so that they can apply and adapt the strategies they develop to other problems and in other contexts. By solving mathematical problems, students acquire ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations that serve them well outside the mathematics classroom.



Executive Summary

Principles and Standards for School Mathematics



Reasoning and Proof. Mathematical reasoning and proof offer powerful ways of developing and expressing insights about a wide range of phenomena. People who reason and think analytically tend to note patterns, structure, or regularities in both real-world and mathematical situations. They ask if those patterns are accidental or if they occur for a reason. They make and investigate mathematical conjectures. They develop and evaluate mathematical arguments and proofs, which are formal ways of expressing particular kinds of reasoning and justification. By exploring phenomena, justifying results, and using mathematical conjectures in all content areas and—with different expectations of sophistication—at all grade levels, students should see and expect that mathematics makes sense.



Six Principles for School Mathematics

- ◊ Equity
- ◊ Learning
- ◊ Curriculum
- ◊ Assessment
- ◊ Teaching
- ◊ Technology

Equity. Excellence in mathematics education requires equity—high expectations and strong support for all students.

Curriculum. A curriculum is more than a collection of activities; it must be coherent, focused on important mathematics, and well articulated across the grades.

Teaching. Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.

Learning. Students must learn mathematics with understanding, actively building new knowledge from experience and previous knowledge.


Assessment. Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.

Technology. Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.

WKCE Mathematics Test Format

- **4-5 Sessions**
- **Estimated Time:**
 - Approximately 160 minutes grades 3-5
 - 180 minutes grades 6-8, 10
- **Selected response (multiple choice)** (approx. 80% of score points)
 - one point
 - assigned to one reporting category
- **Constructed response** (approx. 20% of score points)
 - **Grades 3-8**
 - one point – content
 - two points – process
 - **Grade 10** (assigned to process & content)
 - brief CR items – 2 points
 - extended CR items – 4 points
- **Mathematics tools**
 - Manipulatives (pattern blocks, tangrams, pentominos)
 - Measuring tools (ruler, protractor)
 - Calculators

Wisconsin Knowledge and Concepts Examinations
http://dpi.wi.gov/oea/wkce.html



 WKCE Released Items

<http://dpi.wi.gov/oea/releaseitems.html>

 Including assessment checklists and samples of scored student work

Grade	Item Books	Answer Key
3	Mathematics Reading Guide	
4	Mathematics Reading Guide	
5	Mathematics Reading Guide	
6	Mathematics Reading Guide	
7	Mathematics Reading Guide	
8	Mathematics Reading Guide	
10	Mathematics Reading Guide	
All	Mathematics Reading and Guide(10MB)	

WKCE

 Released Items 2005

 7th Grade Math

 page 331/556

18 Dan and Jen are making chocolate chip cookies for a bake sale. The chocolate chip cookie recipe is shown below.

Chocolate Chip Cookies

1/2 cup butter
1 egg
3/4 cup sugar
1 1/4 cups flour
1/2 teaspoon salt
1/2 teaspoon vanilla
1/2 cup chocolate chips

This recipe makes 50 cookies.

Step A

Dan and Jen need to make 150 cookies for the bake sale. How many cups of flour will they need in order to make 150 cookies?

Answer: _____ cups of flour

Step B

Using the same recipe and what you know about fractions and whole numbers, write a similar word problem. The number of cookies needed must not be 50 or 150. Your word problem should ask for the number of cups of sugar that should be used. Solve your problem and show all your work.

WKCE 7th Grade, 2005-06

18 Dan and Jen are making chocolate chip cookies for a bake sale. The chocolate chip cookie recipe is shown below.

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1/2 cup butter
1 egg
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1/2 teaspoon salt
1/2 teaspoon vanilla
1/2 cup chocolate chips

This recipe makes 50 cookies.

Step A

Dan and Jen need to make 150 cookies for the bake sale. How many cups of flour will they need in order to make 150 cookies?

Answer: _____ cups of flour

Step A: Response is limited to correct answer or range below

$\frac{3}{4}$

Step B

Using the same recipe and what you know about fractions and whole numbers, write a similar word problem. The number of cookies needed must not be 50 or 150. Your word problem should ask for the number of cups of sugar that should be used. Solve your problem and show all your work.

Step B: Responses may include, but may not be limited to, the Answer Cues below

2 points: Both of the following tasks are accomplished:

- The student creates a word problem using a new number of cookies needed (must not be 150 nor 50), and asking for the number of cups of sugar that will be used.
- The student shows a mathematically correct solution to the problem, using ratios or proportions with the fraction $\frac{3}{4}$.

1 point: One of the following applies:

- The student accomplishes only the first of the above tasks.
- The student accomplishes both of the above tasks, but with a computational error. [See Note.]
- The student accomplishes both of the above tasks, but uses 50 or 150 cookies, contrary to instructions.
- The student correctly calculates the number of cups of a different ingredient.
- The student gives and uses a different recipe, but calculates the number of cups of sugar correctly, according to the different recipe.

0 points: The student provides a completely incorrect explanation or justification, or one that cannot be interpreted.

Note: If an arithmetic error leads to loss of credit for Step A, and the process is otherwise correct, award full credit for Step B. The errors include (a) an incorrectly calculated ratio of "recipe cookies" to "cookies needed"; (b) incorrect simplification of the fraction $\frac{3}{4}$.

Institute of Education Sciences U.S. Department of Education

 NATIONAL CENTER FOR EDUCATION STATISTICS

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Trends in International Mathematics and Science Study (TIMSS)

Publications & Products | Staff | International Comparisons in Education

Overview

TIMSS 2003 Results

TIMSS 1999 Results

Benchmarking Studies

Video Studies

Data Files

Released Items

Countries

Partners

Frequently Asked Questions

International Education Indicators

Join NewsFlash

Released Items

A variety of resources have been created by NCES to make the TIMSS curriculum and assessment information available to schools in a ready-to-use form.

Approximately half of the items used in the TIMSS assessment are released to the public after each round of testing. These mathematics and science items can be used by educators in any number of ways:

- To inform discussions about your schools' mathematics and science curriculum;
- To explore the links between concepts you teach and ways to measure students' understanding;
- To design your own assessment according to your needs; and
- To reflect on the performance of your students in comparison to the performance of students in other countries, including the United States.

Each item that appears in the files is shown in two ways: the item with a scoring guide and statistics on the percentage of students in the participating countries that correctly answered the question, and, the item alone, without the scoring guide and statistics. To make it easier to locate items of interest, the files are listed below with a short descriptive text to indicate the grade, subject, and content topic covered.

Recommendation 7: Help students build explanations by asking and answering deep questions.



When students have acquired a basic set of knowledge about a particular topic of study and are ready to build a more complex understanding of a topic, we recommend that teachers find opportunities to ask questions and model answers to these questions. By deep explanations we mean explanations that appeal to causal mechanisms, planning, well-reasoned arguments, and logic. Examples of deep explanations include those that inquire about causes and consequences of historical events, motivations of people involved in historical events, scientific evidence for particular theories, and logical justifications for the steps of a mathematical proof.

Examples of the types of questions that prompt deep explanations are why, why-not, how, what-if, how does X compare to Y, and what is the evidence for X? These questions and explanations can occur both during classroom instruction, class discussion, and during independent study.

A meta-analysis⁷³ of dozens of studies support the claim that comprehension and learning improves from interventions that explicitly train students how to ask deep-level questions while reading text, listening to lectures, or studying material.⁷⁴ The research has involved classroom discussion, workbooks that provided didactic training with definitions of question types and examples, and pedagogical agents on computers (i.e., talking heads) that modeled question asking and answering. These manipulations have been found to increase the rate of student questions, the depth of their questions, and/or their comprehension of the material.

How to carry out the recommendation ...

1. Periodically encourage students to "think aloud" in speaking or writing their explanations as they study the material.⁷⁵ After presenting their explanations, it is beneficial for them to get feedback by observing good explanations of peers, tutors, teachers, and computer environments.

2. Ask questions that elicit explanations, such as those with the following question stems: why, what caused X, how did X occur, what if, what-if-not, how does X compare to Y, what is the evidence for X, and why is X important?⁷⁶

3. Ask questions that challenge students' prior beliefs and assumptions, thereby promoting more intensive and deeper reasoning.⁷⁷



Pre-Algebra Scoring Rubric for Photo Wall

For each category, choose the level that best describes the student's work.

Category	Level 1	Level 2	Level 3	Level 4
Problem Solving	Student uses a single strategy to solve the problem.	Student uses two or more strategies to solve the problem.	Student uses a variety of strategies to solve the problem.	Student uses a variety of strategies to solve the problem, and explains the reasoning.
Communication	Student communicates the solution in a single sentence.	Student communicates the solution in a paragraph.	Student communicates the solution in a paragraph, and explains the reasoning.	Student communicates the solution in a paragraph, and explains the reasoning, and includes a diagram or drawing.

	novice	apprentice	practitioner	expert
Problem Solving				
interpretation				
strategy				
accuracy				
Communication				
completeness				
clarity				
reflection				



Springfield Public School District 186

Site Map

- K-5 Math Home
- Assessment
- Basic Information
- Content
- Process
- Resources online

K-5 Mathematics: Assessment

NOTE: many of these files are in a portable document format (PDF); you will need Adobe Acrobat Reader to view/print them.

- 2007-2008 Dates for Administration
- District Assessment Information
- District Math Framework
- Types of Assessment

Extended Response

- Grade Kindergarten Quarter 3, Quarter 4
- Grade One Quarter 1, Quarter 2, Quarter 3, Quarter 4
- Grade Two Quarter 1, Quarter 2, Quarter 3, Quarter 4
- Grade Three Quarter 1, Quarter 2, Quarter 3, Quarter 4
- Grade Four Quarter 1, Quarter 2, Quarter 3, Quarter 4
- Grade Five Quarter 1, Quarter 2, Quarter 3, Quarter 4

Language Stages and Language Phases

Writing and Assessment

- Building a Supportive Classroom Culture
- Strategies for Supporting Talking and Writing
- Tips for Improving Writing
- Options for Writing in Math

<http://www.springfield.k12.il.us/resources/math/assessment.html>

Grade 1 - Student #6 - Quarter 1

Assessment

K-3 S-3 E-3

Task 1: combination of 10 items (10 items)

Task 2: combination of 10 items (10 items)

Task 3: combination of 10 items (10 items)

Task 4: combination of 10 items (10 items)

Task 5: combination of 10 items (10 items)

Task 6: combination of 10 items (10 items)

Task 7: combination of 10 items (10 items)

Task 8: combination of 10 items (10 items)

Task 9: combination of 10 items (10 items)

Task 10: combination of 10 items (10 items)

Task 11: combination of 10 items (10 items)

Task 12: combination of 10 items (10 items)

Task 13: combination of 10 items (10 items)

Task 14: combination of 10 items (10 items)

Task 15: combination of 10 items (10 items)

Task 16: combination of 10 items (10 items)

Task 17: combination of 10 items (10 items)

Task 18: combination of 10 items (10 items)

Task 19: combination of 10 items (10 items)

Task 20: combination of 10 items (10 items)

Task 21: combination of 10 items (10 items)

Task 22: combination of 10 items (10 items)

Task 23: combination of 10 items (10 items)

Task 24: combination of 10 items (10 items)

Task 25: combination of 10 items (10 items)

Task 26: combination of 10 items (10 items)

Task 27: combination of 10 items (10 items)

Task 28: combination of 10 items (10 items)

Task 29: combination of 10 items (10 items)

Task 30: combination of 10 items (10 items)

Springfield Public School District 186

A Guide to Writing Mathematics

Dr. Kevin P. Lee


Introduction

This is a math class! Why are we writing?

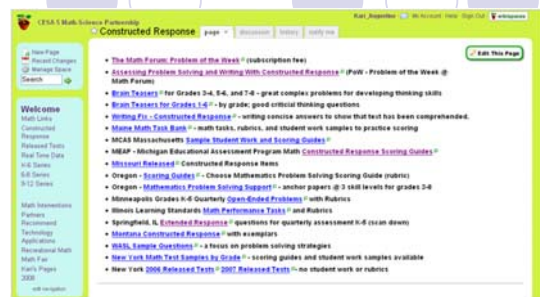
There is a good chance that you have never written a paper in a math class before. So you might be wondering why writing is required in your math class now.

The Greek word *mathēmatikē*, from which we derive the word mathematics, embodies the notions of knowledge, cognition, understanding, and perception. In the end, mathematics is about ideas. In math classes at the university level, the ideas and concepts encountered are more complex and sophisticated. The mathematics learned in college will include concepts which cannot be expressed using just equations and formulas. Putting *mathematics* on paper will require writing sentences and paragraphs in addition to the equations and formulas.

Mathematicians actually spend a great deal of time writing. If a mathematician wants to contribute to the greater body of mathematical knowledge, she must be able to communicate her ideas in a way which is comprehensible to others. Thus, being able to write clearly is as important a mathematical skill as being able to solve equations.




[A Guide to Writing Mathematics](http://ems.calumet.purdue.edu/mcss/kevinlee/mathwriting/writingman.pdf)
<http://ems.calumet.purdue.edu/mcss/kevinlee/mathwriting/writingman.pdf>



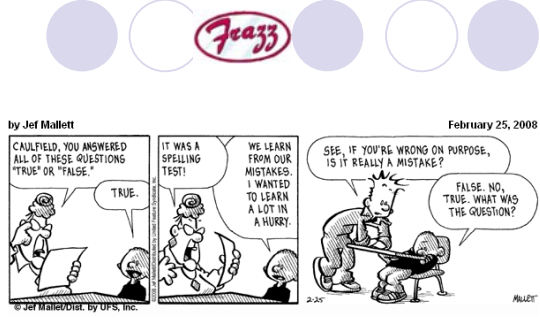
Wikispaces ~ Constructed Response

<http://cesa5mathscience.wikispaces.com/Constructed+Response>




Wikispaces ~ State and National Released Tests

<http://cesa5mathscience.wikispaces.com/State+%26+National+Assessment>



by Jef Mallett

February 25, 2008



Hope you found something you can use to help you learn from your students' experiences, and to change yourself!

Thanks for coming,
 Kari Augustine